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DESCRIPTION

Substrate Adsorption Device and Substrate Bonding Device

Cross Reference to Related Applications

The disclosure of Japanese Patent Application No. 2004-009021 filed January 16, 2004, including specification, drawings and claims is incorporated herein by reference in its entirety.

Technical Field

The present invention relates to a substrate adsorption device and a substrate bonding device including a stage for holding by adsorbing a substrate, and particularly relates to countermeasures for preventing malfunction caused due to the existence of a foreign matter between the stage and the substrate.

Background Art

Conventionally, substrate adsorption devices for holding by adsorbing a substrate as an object to be processed to a flat stage have been known (see Patent Document 1 and Patent Document 2, for example.).

FIG. 12 is a perspective view schematically illustrating the main portion of a substrate adsorption device **100**, and FIG. **13** is a side view schematically illustrating a substrate bonding device **120** composed of a pair of the substrate adsorption devices **100** facing each other.

As shown in FIG. **12** and FIG. **13**, each substrate adsorption device **100** includes a stage **101** for holding by adsorbing a substrate **110** at an adsorption face **102**. A plurality of adsorption ports **103** opening in the adsorption face **102** are formed in the stage **101**. The adsorption ports **103** are formed at, for example, four corners of the stage **101**, respectively. Further, the adsorption ports **103** are connected to a vacuum pump **104** through an air discharge path **107**. With this construction, the substrate **110** is adsorbed and held by

driving a vacuum pump **104** while the substrate **110** is placed on the adsorption face **102** of the stage **101**.

When the substrate **110** as an object to be processed is not fixed securely and moves on the stage, the substrate **110** cannot be processed accurately. For this reason, the substrate adsorption device **100** is demanded to be capable of holding and adsorbing the substrate **110** securely.

In order to satisfy the above demand, a pressure gage **118** is provided in the air discharge path **107** that connects the adsorption ports **103** and the vacuum pump **104** in Patent Document 1. When the pressure within the air discharge path **107** detected by the pressure gage **118** is larger than a predetermined value, the state that the substrate **110** is not adsorbed securely is detect.

On the other hand, in Patent Document 2, though not shown, a plurality of adsorption trenches are formed in the surface portion of the stage and adsorption ports are formed in the bottom of the adsorption trenches. Vacuum force is generated sequentially, differentially in time in the adsorption trenches, to restrict bow of the substrate accompanied by adsorption and to prevent leakage of the vacuum force.

The substrate adsorption device **100** is used for, for example, a substrate bonding device **120** for manufacturing a liquid crystal display panel by bonding a pair of substrates. In general, the liquid crystal display panel is composed of a TFT substrate in which a plurality of switching elements such as TFTs are provided, a counter substrate in which a color filter and the like are provided, and a liquid crystal layer interposed between the TFT substrate and the counter substrate.

Each of the TFT substrate and the counter substrate includes, as shown in FIG. **13**, a glass substrate **110** and an alignment film **111** uniformly provided on the glass substrate **110**. The alignment film **111** is provided for defining the initial orientation of the liquid crystal molecules of the liquid crystal layer.

The stages **101** of the substrate adsorption devices **100** are moved to be closed to

and press against each other while adsorbing the glass substrates **110**, respectively, to bond the TFT substrate and the counter substrate to each other. Wherein, a lage number of, for example, spacers **112** are sprayed on the surface of the assignment film **111** of the TFT substrate. Each spacer **112** is formed of a ball-shaped particle for keeping a predetermined space between the TFT substrate and the counter substrate.

If a foreign matter **105** such as dust, a metal particle and the like exists between the adsorption face **102** of the stage **101** and the glass substrate **110**, the glass substrate **110** is deformed in a convex shape locally by the foreign matter **105**, as shown in a side section of FIG. **14**. As a result, the foreign matter **105** may scratch the glass substrate **110**, so that the glass substrate **110** becomes defective. Further, the foreign matter **105** causes pressure concentration at a part where the foreign matter **105** exists, as shown in a side view of FIG. **15**, to scratch the alignment film **111** or the glass substrate **110** in bonding the TFT substrate and the counter substrate.

In this connection, there is a known technique that a region of the stage corresponding to the central region of the glass substrate (e.g., a display region) is recessed (see, for example, Patent Document 3). In detail, as shown in a side section of FIG. **16**, the recessed portion **101a** is formed in the middle of the stage **101**. The adsorption face **101** is formed around the recessed potion **101a** and a plurality of adsorption ports **103** are formed in the adsorption face **102**. With this construction, the glass substrate **110** can be kept away from the foreign matter **105** with a predetermined space left between the bottom of the recessed portion **101a** and the glass substrate **110** even if the foreign matter **105** enters within the recessed portion **101a**.

(Patent Document 1) Japanese Patent Application Laid Open Publication No. 11-288957A

(Patent Document 2) Japanese Patent Application Laid Open Publication No. 9-80404A

(Patent Document 3) Japanese Patent Application Laid Open Publication No.

10-268325A

Disclosure of the Invention

However, in the substrate adsorption device of Patent Document 3, for adsorbing and holding a various kinds of substrates difference in size securely, it is necessary to change the size of the recessed portion according to the sizes of the substrates. In this connection, the stage must be exchanged for respective different-sized substrates, which increases device cost and involves labor for exchanging the stages.

Recently, size and variation of the liquid crystal panels are increasing, and therefore, the above problem is significant in substrate adsorption devices for holding such liquid crystal panels.

In addition, in Patent Document 3, a foreign matter larger than the depth of the recessed portion may be in contact with the substrate, with a result of no effect exhibited.

The present invention has been made in view of the above problems and has its object of preventing a flaw on a substrate by detecting existence of a foreign matter, which is a factor of a flaw on the substrate, with a low-cost and simple construction of a substrate adsorption device for holding by adsorbing the substrate and a substrate bonding device provided therewith.

To attain the above object, a plurality of leak trenches open to both an adsorption face of a stage and a side face of the stage are formed in the present invention.

Specifically, a substrate adsorbing device according to the present invention includes: a stage including an adsorption face for holding a substrate; a plurality of adsorption ports formed in a region of the adsorption face of the stage; an air discharge path connected to each of the adsorption ports; pressure reducing means connected to the adsorption ports through the discharging path; and pressure detecting means that detects pressure in the air discharge path, wherein a plurality of leak trenches open to both the adsorption face of the stage and a side face of the stage are formed in a region of the stage

except a region where the adsorption ports are formed.

The pressure detecting means may be provided in the air discharge path for each of the adsorption ports.

For each of the adsorption ports, the pressure detecting means and an opening/closing mechanism for opening/closing the corresponding adsorption port based on a pressure state detected by the corresponding pressure detecting means may be provided in the air discharge path.

It is preferable that the opening/closing mechanism closes the corresponding adsorption port when the pressure detecting means does not detect a vacuum state.

It is preferable to form the leak trenches in a grid pattern in the region of the adsorption face of the stage.

It is preferable to form the adsorption ports at centers of regions surrounded by the leak trenches formed in the grid pattern, respectively.

The leak trenches may be formed in a stripped pattern in the region of the adsorption face of the stage.

A substrate bonding device according to the present invention includes two substrate adsorption devices as above, the substrate adsorption devices are arranged so that the adsorption faces of the stages face each other, and the stages are allowed to be close to each other while adsorbing and holding substrate, respectively, to bond the substrates to each other.

-Operation-

Operation of the present invention will be described next.

For adsorbing and holding the substrate by the substrate adsorption device, the substrate is placed on the adsorption face of the stage first. Then, the pressure reducing means is driven to discharge the air between the substrate and the adsorption face from the adsorption ports through the air discharge path. In other words, vacuum force is generated between the substrate and the adsorption face. Whereby, the substrate adsorption device

holds by adsorbing the substrate at a predetermined position on the stage.

If a foreign matter enters between the substrate and the adsorption face, the substrate adsorbed to the adsorption face is deformed in a convex shape locally by the foreign matter. Namely, a certain space is created around the foreign matter between the substrate and the adsorption face. The space communicates with the adsorption ports and the leak trenches so that the air in the space is discharged through the adsorption ports while air is introduced to the space from the leak trenches. As a result, the pressure in the air discharge path detected by the pressure detecting means becomes larger when a foreign matter exists than the case with no foreign matter exists. In other words, whether a foreign matter exists between the substrate and the adsorption face or not can be judged according to the pressure detected by the pressure detecting means.

It should be noted that the substrate hermetically plugs the adsorption ports by elastic deformation even with a foreign matter exists in the conventional substrate adsorption devices, as shown in FIG. 14. In this connection, even with the above pressure detecting means provided, a foreign matter cannot be detected through the pressure detecting means because the pressure detected through the pressure detecting means is constant regardless of the presence or absence of a foreign matter between the substrate and the adsorption face.

Further, provision of the pressure detecting means at each adsorption port of the air discharge path enables to detect the pressure of air discharged from each adsorption port, and accordingly, the position of a foreign matter, if exists between the substrate and the adsorption face, can be specified.

Moreover, the opening/closing mechanism is provided at each adsorption port of the air discharge path in combination with the pressure detecting means, which enables opening/closing of each adsorption port based on the detected pressure. Especially, when the opening/closing mechanism closes an adsorption port of which vacuum state is not detected by the pressure detecting means, leakage through the adsorption port stops. As a

result, the substrate can be held securely at the other adsorption ports of which vacuum states are detected.

In addition, the formation of the leak trenches in a grid pattern or in a stripped pattern enables uniform detection of a foreign matter on the adsorption face.

For bonding substrates by the substrate bonding device, the substrates are placed on the stages, respectively, and the substrates are adsorbed and held to the adsorption faces of the stages of the substrate adsorption devices, respectively, by driving the pressure reducing means. Then, the stages are allowed to be closed to and pressed against each other with the substrates being held and adsorbed. Whereby, the substrates are bonded to each other with no foreign matter left between the substrates and the adsorption faces.

In the substrate adsorption device according to the present invention, a foreign matter, which is a factor of damaging the substrate, left between the substrates and the adsorption faces can be detected according to the pressure detected by the pressure detecting means, and thus, a flaw on the substrate is prevented

Brief Description of the Drawing

FIG. 1 is a perspective view schematically illustrating the main portion of a substrate adsorption device in the first embodiment.

FIG. 2 is a section showing a side section of the substrate adsorption device in the first embodiment.

FIG. 3 is a side view schematically illustrating a substrate bonding device including the substrate adsorption devices in the first embodiment.

FIG. 4 is a perspective view schematically illustrating the main portion of a substrate adsorption device in the second embodiment.

FIG. 5 is a section showing a side section of a substrate adsorption device in the third embodiment.

FIG. 6 is a section showing a side section of a substrate adsorption device in the

fourth embodiment.

FIG. **7** is a perspective view schematically illustrating a sealing material dispenser in the fifth embodiment.

FIG. **8** is an explanatory drawing showing an exposure apparatus and optical paths in the sixth embodiment.

FIG. **9** is a side view illustrating a chopper in the seventh embodiment.

FIG. **10** is a perspective view schematically illustrating a web cleaner in the eighth embodiment.

FIG. **11** is an explanatory drawing schematically illustrating a coating apparatus in the ninth embodiment.

FIG. **12** is a perspective view schematically illustrating the main portion of a conventional substrate adsorption device.

FIG. **13** is a side view illustrating a substrate bonding device including conventional substrate adsorption devices.

FIG. **14** is a side section showing the state where a foreign matter enters in the conventional substrate adsorption device.

FIG. **15** is a side view showing the state where a foreign matter enters in the conventional substrate bonding device.

FIG. **16** is a side section illustrating a conventional substrate adsorption device including a stage in which a recessed portion is formed.

Best Mode for Carrying Out the Invention

The embodiments of the present invention will be described below with reference to accompanying drawings. Wherein, the present invention is not limited to the following embodiments.

<First Embodiment>

FIG. **1** through FIG. **3** show an embodiment of a substrate adsorption device **1** and

a substrate bonding device **2** according to the present invention. FIG. **1** is a perspective view schematically illustrating the substrate adsorption device **1**, FIG. **2** is a section schematically illustrating the substrate adsorption device **1**, and FIG. **3** is a side view of the substrate bonding device **2**.

The substrate bonding device **2** is a device used for manufacturing, for example, a liquid crystal display panel by bonding a pair of substrates **20**, and is composed of the two substrate adsorption devices **1**, as shown in FIG. **3**.

The liquid crystal display panel is composed of a TFT substrate **20a** in which a plurality of switching elements such as TFTs are provided, a counter substrate **20b** in which a color filter and the like are provided, and a liquid crystal layer (not shown) interposed between the TFT substrate **20a** and the counter substrate **20b**, as shown in FIG. **3**. An alignment film **21** is uniformly formed on each surface of the TFT substrate **20a** and the counter substrate **20b**. The alignment film **21** defines the initial orientation of liquid crystal molecules in the liquid crystal layer. A large number of spacers **22** are splayed on the alignment film **21** of the TFT substrate **20a** or the counter substrate **20b**. The spacers **22** are ball-shaped particles for keeping a predetermined space between the TFT substrate **20a** and the counter substrate **20b**.

Each of the TFT substrate **20a** and the counter substrate **20b**, which are glass substrates, has a thickness in the range between 0.6 mm and 1.1 mm, both inclusive, and a size of, for example, 680 mm wide and 880 mm long.

The substrate adsorption device **1** includes: a stage **11** having an adsorption face **12** for holding the substrate **20**, which is the TFT substrate **20a** or the counter substrate **20b**; a plurality of adsorption ports **13** formed in a region of the adsorption face **12** of the stage **11**; and a vacuum pump **14** serving as pressure reducing means which is connected to each adsorption port **13** through an air discharge path **17**, as shown in FIG. **1** and FIG. **2**. The substrate **20** is adsorbed and held to the adsorption face **12** of the stage **11** by driving the vacuum pump **14**.

The stage **11** is formed of a plate member made of, for example, aluminum or the like and having a predetermined thickness. It is preferable that the adsorption face **12** of the stage **11** is subjected to anodic oxidation. The stage **11** is formed to have a size of, for example, 1000 mm wide and 1000 mm long. As shown in FIG. **3**, a part of which is omitted, an elevating machine **25**, such as an air cylinder, for moving up and down the stage **11** is provided in back of each stage **11** (i.e., the side opposite the adsorption face **12**).

The adsorption face **12** is a flat face for holding by adsorbing the substrate **20** in a flat plate state. The adsorption ports **13** are formed open to the adsorption face **12** and arranged in matrix in the adsorption face **12**, as shown in FIG. **1**.

The air discharge path **17** is formed inside and outside the stage **11**, as shown in FIG. **2**, and connects the adsorption ports **12** to the vacuum pump **14**. In detail, the air discharge path **17** extends from each adsorption port **13** to the inside of the stage **11** and is gathered into a single path of the air discharge path **17**, and the end thereof is connected to a suction port (not shown) of the vacuum pump **14**.

In the air discharge path **17**, pressure sensors **18** are provided which serve as pressure detecting means for detecting the pressure inside the air discharge path **17**. The pressure sensors **18** are provided at the adsorption ports **13**, respectively, as shown in FIG. **2**. With the pressure sensors **18**, each pressure of the air discharged from the adsorption ports **13** is detected separately.

A plurality of leak trenches **30** are formed in a grid pattern in the adsorption face **12** of the stage **11**. The leak trenches **30** are formed, as shown in FIG. **2**, in a region except the region where the adsorption ports **13** are formed, and are open outside to both the adsorption face **12** of the stage **11** and the side faces of the stage **11**. In other words, the inside of the leak trenches **30** communicates with outside of the stage **11** so as to be open to air when the substrate **20** is placed on the adsorption face **12**. The leak trenches **30** have a trench depth and width of 2 mm, and are formed at regular intervals of 100 mm.

Each adsorption port **13** is formed to have a diameter of, for example, 20 mm, and is arranged at the center of the region surrounded by the plurality of leak trenches **30** formed in a grid pattern. Namely, the adsorption ports **13** are arranged, for example, in the 100 mm pitch, similar to the leak trenches **30**.

The substrate bonding device **2** is composed of paired substrate adsorption devices **1** arranged so that the adsorption faces **12** of the stages **11** face each other, as shown in FIG. 3. The stages **11** are allowed to be close to each other while the substrates are adsorbed and held, thereby bonding the substrates.

-Operation of Device-

Each operation of the substrate adsorption device **1** and the substrate bonding device **2** will be described next.

For adsorbing and holding the substrate **20** by the substrate adsorption device **1**, the substrate **20** is placed on the adsorption face **12** of the stage **11** first. Then, the vacuum pump **14** is driven to discharge air between the substrate **20** and the adsorption face **12** from each adsorption port **13** through the air discharge path **17**, so that vacuum force is generated between the substrate **20** and the adsorption face **12**. Whereby, the substrate adsorption device **1** holds by adsorbing the substrate **20** at a predetermined position on the stage **11**. At this time, the pressure sensor **18** detects the pressure inside the air discharge path **17** that might become vacuum, to confirm that the pressure is not exceeding a predetermined value.

While, a particle of metal, glass, or the like, which is a foreign matter **15**, may be adhered to the substrate **20** in the previous process, to enter between the substrate **20** and the adsorption face **12**. If the foreign matter **15** is left between the substrate **20** and the adsorption face **20**, the substrate **20** adsorbed to the adsorption face **12** is deformed into a convex shape locally by the foreign matter **15**, as shown in FIG. 2.

In the conventional substrate bonding device **120** with no leak trenches formed, pressure concentration is caused between the substrates **20** in bonding of the substrates **20**,

and the alignment film **21** is scratched when the size of the foreign matter **15** is larger than 15 mm. Further, the substrates **20** themselves may be scratched by the foreign matter **15**.

In contrast, each interval of the leak trenches **30** and the adsorption ports **13** is formed at regular intervals of 100 mm in the case where the glass substrates **20** having a predetermined elasticity has a thickness in the range between 0.6 mm and 1.1 mm, both inclusive. Therefore, the space **35** between the substrate **20** and the adsorption face **12**, which is created around the foreign matter **15** of 0.5 mm or larger in size, can communicate with both an adsorption port and the leak trenches **30**.

As a result, air is introduced from the leak trenches **30** while the air in the space **35** is discharged from the adsorption ports **13**, so that the pressure in the air discharge path **17** detected by the pressure sensor **18** becomes larger when the foreign matter **15** exists than when the foreign matter **15** does not exist. Thus, the foreign matter **15** is detected according to the value of the pressure sensor **18**.

Upon detection of the foreign matter **15**, the substrates **20** are cleaned to remove the foreign matter **15** before bonding the substrates **20** actually.

Thereafter, the TFT substrate **20a** and the counter substrate **20b**, which are substrates **20**, are adsorbed and held to the stages **11** of the paired substrate adsorption devices **1**, respectively, with no foreign matter **15** left, and the stages **11** are allowed to be closed to each other by the elevating machine **25**. Subsequently, the pressure is applied to the TFT substrate **20a** and the counter substrate **20b** to bond them to each other. Then, a liquid crystal material is injected into a space (cell gap) between the TFT substrate **20a** and the counter substrate **20b**, thereby completing a liquid crystal display panel.

-Effects in First Embodiment-

The size of the space **35** created around the foreign matter **15** between the substrate **20** and the adsorption face **12** depends on the relationship between the thickness of the substrate **20** and the size of the foreign matter **15** existing between the substrate **20** and the adsorption face **12**, which is a factor of a flaw on the alignment film **21** and the substrate

20 itself. According to the present embodiment, interval setting of the leak trenches **30** and the like, taking the foregoing relationship in consideration, enables communication of the space **35** with both the adsorption ports **13** and the leak trenches **30**.

Hence, the pressure in the air discharge path **17** can be made larger when the foreign matter **15** exists between the substrate **20** and the adsorption face **12** than when the foreign matter **15** does not exists therebetween by introducing air to the space **35** from the leak trenches **30** while discharging the air in the space **35** from the adsorption ports **13**. As a result, detection of the pressure in the air discharge path **17** by the pressure sensors **18** leads to judgment as to whether the foreign matter **15** exists therebetween.

Further, the uniform formation of the leak trenches **30** in the stage **11** secures substrate adsorption and holing, and detection of a foreign matter in a plurality of substrates different in size. In other words, it is unnecessary to exchange stages for respective substrates different in size, and therefore, the device cost is reduced and labor for exchanging the stages is dispensed with. A flaw on the substrate **20** and the like caused by entering of the foreign matter **15** is prevented with low cost and simple construction, regardless of the size of the substrates.

Further, the provision of the pressure sensor **18** at each adsorption port **13** enables detection of the pressure of the air discharged from each adsorption port **13**. Hence, the position of the foreign matter **15** existing between the substrate **20** and the adsorption face **12** can be specified.

Moreover, the formation of the leak trenches **30** in a grid pattern enables uniform detection of the foreign matter **15** on the adsorption face **12**.

In addition, the application of the substrate adsorption devices **1** to the substrate bonding device **2** enables bonding of the substrates **20** with no foreign matter **15** left between the substrates **20** and the adsorption faces **12**, thereby enhancing the quality of the liquid crystal display panel as a product.

<Second Embodiment>

FIG. 4 shows the second embodiment according to the present invention. Wherein, the same reference numerals are assigned to the same members as in FIG. 1 through FIG. 3 and the detailed description thereof is omitted in the following embodiments.

FIG. 4 is a perspective view illustrating the stage 11 in the second embodiment. In the substrate adsorption devices 1 applied to the substrate bonding device 2 in the present embodiment, the leak trenches 30 are formed in a region of the adsorption face 12 in a stripped pattern, which is the feature.

In detail, the plural leak trenches 30 are formed in the stage 11 in parallel with one another at regular intervals. The plural adsorption ports 13 are arranged along the leak trenches 30 at regular intervals between the corresponding adjacent leak trenches 30. Each adsorption port 13 is formed at the center between the corresponding adjacent leak trenches 30. Thus, the formation of the leak trenches 30 in a stripped pattern can attain the same effects in the first embodiment.

<Third Embodiment>

FIG. 5 shows the third embodiment according to the present invention. In the present embodiment, valves 19 serving as an opening/closing mechanism are added to the substrate adsorption devices 1 in the first embodiment.

In detail, for each adsorption port 13, the pressure sensor 18 and a valve 19 for opening/closing the adsorption port 13 based on the pressure detected by the pressure sensor 18 are provided in the air discharge path 17, as show in FIG. 5. The valve 19 closes the corresponding adsorption port 13 when the corresponding pressure sensor 18 does not detect the vacuum state.

For adsorbing and holding the substrate 20 by the substrate adsorption device 1, the substrate 20 is placed on the adsorption face 12 of the stage 11 and the air between the substrate 20 and the adsorption face 12 is discharge from each adsorption port 13 through the air discharge path 17 in the same way as in the first embodiment.

If the foreign matter 15 exists between the substrate 20 and the adsorption face 12

at that time, the substrate **20** adsorbed to the adsorption face **12** is deformed in a convex shape locally by the foreign matter **15**.

In so doing, the glass substrate **20** closes the adsorption ports **13** in the region of the stage **11** where the foreign matter **15** does not exists, so that the pressure sensors **18** detects the vacuum state in the air discharge path **17** continuing to the adsorption ports **13**.

On the other hand, in the region of the stage **11** where the foreign matter **15** exists, both the adsorption port **13** and the leak trench **30** communicate with the space **35** created around the foreign matter **15** between the substrate **20** and the adsorption face **12**. In this connection, a comparatively large value of pressure is detected in the air discharge path **17** continuing to the adsorption port **13** communicating with the space **35**, which means no detection of the vacuum state. Upon no detection of the vacuum state, the valve **19** is driven to close the adsorption port **13** communicating the space **35**.

Hence, according to the present embodiment, the existence of a foreign matter can be detected according to the detected values by the pressure sensors **18** and the glass substrate **20** can be adsorbed and held securely with no air leakage from the lead trenches **30** even when the foreign matter **15** exists between the stage **11** and the glass substrate **20**.

<Fourth Embodiment>

Fig. **6** shows the fourth embodiment according to the present invention. While the pressure sensor **18** is provided for each of the adsorption ports **13** in the first embodiment, only one pressure sensor **18** is provided in the present embodiment.

In detail, as shown in the section of FIG. **6**, the pressure sensor **18** is provided at the confluence portion of the air discharge path **17** so as to detect the pressure of the air discharged from each adsorption port **13** and introduced into the vacuum pump **14**.

With this construction, the pressure at the confluence portion of the air discharge path **17** becomes large when air is introduced from a leak trench **30**, with a result of detection of the foreign matter **15** from the pressure sensor **18**. Further, the reduction of the number of the pressure sensors **18** leads to reduction of the device cost.

<Fifth Embodiment>

FIG. **7** shows the fifth embodiment of the substrate adsorption device **1** according to the present invention. FIG. **7** is a perspective view schematically illustrating a sealing material dispenser **40**.

The sealing material dispenser **40** includes the substrate adsorption device **1** for holding by adsorbing the substrate **20**, and cylinders **41** for discharging an adhesive so that the adhesive is applied at the predetermined portion on the substrate **20** through the cylinders **41**. The distance between the tip ends of the cylinders **41** and the surface of the substrate **20** is kept to be several micrometers. The stage **11** of the substrate adsorption device **1** is set movable in a two-dimensional direction.

The sealing material dispenser **40** is required to have high accuracy for adhesive plotting to the substrate **20**. However, existence of a foreign matter between the substrate **20** and the adsorption face of the stage **11** changes the distance between the tip ends of the cylinders **41** and the surface of the substrate **20**, with a result of defect in the adhesive application.

For tackling this problem, the substrate adsorption device **1** according to the present invention is applied to the sealing material dispenser **40**, whereby the substrate **20** can be adsorbed and held with no foreign matter left between the substrate **20** and the adsorption face of the stage **11**, thereby preventing a defect in the adhesive application.

<Sixth Embodiment>

FIG. **8** shows the sixth embodiment of the substrate adsorption device **1** according to the present invention. FIG. **8** is an explanatory drawing schematically illustrating an exposure apparatus **50**.

The exposure apparatus **50** is used for forming a layered pattern in the substrate **20** by, for example, photolithography or the like. The exposure apparatus **50** in the present embodiment is an exposure apparatus of proximity printing type, and includes an extra-high pressure mercury lamp **51**, an optical system **55** for setting light of the

extra-high pressure mercury lamp **51** to be parallel rays, and the substrate adsorption device **1** for holding by adsorbing the substrate **20**.

The optical system **55** is composed of, for example, a dichroic mirror **56** for reflecting light of the extra-high pressure mercury lamp **51**, a fly-eye lens **57** for refracting the light reflected on the dichroic mirror **56**, and a convex mirror **58** for setting the light transmitted through the fly-eye lens **57** to be parallel rays.

While the substrate **20** is adsorbed to the stage **11** of the substrate adsorption device **1**, the light is irradiated to the substrate **20** through a mask **53**, to form a predetermined resist pattern in the substrate **20**.

The above exposure apparatus **50** is required to have high exposure accuracy for accurate patterning. However, existence of a foreign matter between the substrate **20** and the adsorption face of the stage **11** bows the substrate **20**, resulting in uninformed exposure. Thus, highly accurate patterning is impossible.

For tackling this problem, the substrate adsorption device **1** according to the present invention is applied to the exposure apparatus **50**. Hence, the substrate **20** is adsorbed and held with no foreign matter exsiting between the substrate **20** and the adsorption face of the stage **11**, thereby preventing exposure irregularity and attaining highly accurate patterning.

It is noted that the substrate adsorption device **1** according to the present embodiment is applicable to other exposure apparatuses such as exposure apparatuses of mirror projection type, stepper type, and the like.

<Seventh Embodiment>

FIG. **9** shows the seventh embodiment of the substrate adsorption device **1** according to the present invention. FIG. **9** is an explanatory drawing schematically showing a chopper **60**.

The chopper **60** chops the substrate **20** such as a liquid crystal display panel and the like into a predetermined size and conveys the chopped substrate **20**. The chopper **60**

includes the substrate adsorption device **1** for holding by adsorbing the substrate **20**, and a chopping mechanism **61** for chopping the substrate **20** held by the substrate adsorption device **1**.

The application of the substrate adsorption device **1** according to the present invention to the chopper **60** prevents damage to the substrate **20**, which is accompanied by chopping and conveyance, because the substrate **20** can be adsorbed and held with no foreign matter left between the substrate **20** and the adsorption face of the stage **11**. Further, in the case where the substrate **20** is a liquid crystal display panel, a flaw on the alignment film can be prevented.

<Eighth Embodiment>

FIG. **10** shows the eighth embodiment of the substrate adsorption device **1** according to the present invention. FIG. **10** is an explanatory drawing schematically illustrating a web cleaner **70**.

The web cleaner **70** includes the substrate adsorption device **1** of which stage **11** is set horizontally movable in a predetermined direction, and a cleaner nozzle portion **71** fixedly held at a predetermined position. The stage **11** adsorbing and holding the substrate **20** is moved horizontally while operating the cleaner nozzle portion **71**, to clean the surface of the substrate **20**.

The cleaner nozzle portion **71** is set to have a comparatively short distance from the substrate **20**. Therefore, if a foreign matter exists between the substrate **20** and the adsorption face of the stage **11**, the cleaner nozzle portion **71** may be in contact with the substrate **20** deformed in a convex shape by the foreign matter, to damage the substrate **20**.

For tackling this problem, the substrate adsorption device **1** according to the present invention is applied to the web cleaner **70**. As a result, the substrate **20** can be adsorbed and held with no foreign matter existing between the substrate **20** and the adsorption face of the stage **11**, so that the substrate **20** is prevented from being contact with the cleaner nozzle portion **71** and is prevented from being damaged.

<Ninth Embodiment>

FIG. **11** shows the ninth embodiment of the substrate adsorption device **1** according to the present invention. FIG. **11** is an explanatory drawing schematically illustrating a coating apparatus **80**.

The coating apparatus **80** includes a device body **81** having the substrate adsorption device **1**, and a capillary nozzle **83** for supplying a coating material **82** onto the substrate **20**. The substrate **20** is adsorbed and held to the stage **11** of the substrate adsorption device **1** and a predetermined amount of the coating material **82** is supplied onto the substrate **20** through the capillary nozzle **83**. Thereafter, the coating material **82** is uniformly spread on the substrate **20** by a coater (not shown).

The application of the substrate adsorption device **1** according to the present invention to the coating apparatus **80** enables adsorption and holding of the substrate **20** with no foreign matter existing between the substrate **20** and the adsorption face of the stage **11**, resulting in prevention of coating irregularity by the coater.

Particularly, coating irregularity in a color resist, an organic interlayer insulating film and the like of a liquid crystal display device, which are used as coated, resist lowers the display quality directly. Therefore, the application of the substrate adsorption device **1** prevents coating irregularity and enhances the display quality.

<Other Embodiments>

The substrate adsorption device **1** according to the present invention is applicable to a polarizing plate bonding device and the like, in addition to the above embodiments. In detail, in a polarizing plate bonding device, pressure is applied to a substrate for bonding a polarizing plate to the substrate, so that the polarizing plate or the substrate itself may be scratched if a foreign matter exists between the substrate and the stage for holding the substrate. For tackling this problem, the substrate adsorbing device **1** according to the present invention is applied to the polarizing plate bonding device. Whereby, a foreign matter is prevented from being left therebetween, similar to each of the above

embodiments, and accordingly, the polarizing plate and the substrate itself are prevented from being damaged.

Further, the arrangement of the leak trenches **30** is not limited to the grid pattern and the stripped pattern. Only required is that the leak trenches **30** are formed so as to be open to outside air under the condition that the substrate is adsorbed and held.

Industrial Applicability

As described above, the present invention is useful in substrate adsorption devices and substrate bonding devices having a stage for holding by adsorbing a substrate, and especially, is suitable to prevent damage to substrates in devices with low-cost and simple construction.